MeshSLAM: Robust Localization and Large-Scale Mapping in Barren Terrain, Phase I

Completed Technology Project (2013 - 2014)

Project Introduction

Robots need to know their location to map of their surroundings but without global positioning data they need a map to identify their surroundings and estimate their location. Simultaneous localization and mapping (SLAM) solves these dual problems at once. SLAM does not depend on any kind of infrastructure and is thus a promising localization technology for NASA planetary missions and for many terrestrial applications as well. However, state-of-the-art SLAM depends on easily-recognizable landmarks in the robot's environment, which are lacking in barren planetary surfaces. Our work will develop a technology we call MeshSLAM, which constructs robust landmarks from associations of weak features extracted from terrain. Our test results will also show that MeshSLAM applies to all environments in which NASA's rovers could someday operate: dunes, rocky plains, overhangs, cliff faces, and underground structures such as lava tubes. Another limitation of SLAM for planetary missions is its significant data-association problems. As a robot travels it must infer its motion from the sensor data it collects, which invariably suffers from drift due to random error. To correct drift, SLAM recognize when the robot has returned to a previously-visited place, which requires searching over a great deal of previously-sensed data. Computation on such a large amount of memory may be infeasible on space-relevant hardware. MeshSLAM eases these requirements. It employs topology-based map segmentation, which limits the scope of a search. Furthermore, a faster, multi-resolution search is performed over the topological graph of observations. Mesh Robotics LLC and Carnegie Mellon University have formed a partnership to commercially develop MeshSLAM. MeshSLAM technology will be available via open source, to ease its adoption by NASA. In Phase 1 of our project we will show the feasibility of MeshSLAM for NASA and commercial applications through a series of focused technical demonstrations.

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Mesh Robotics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

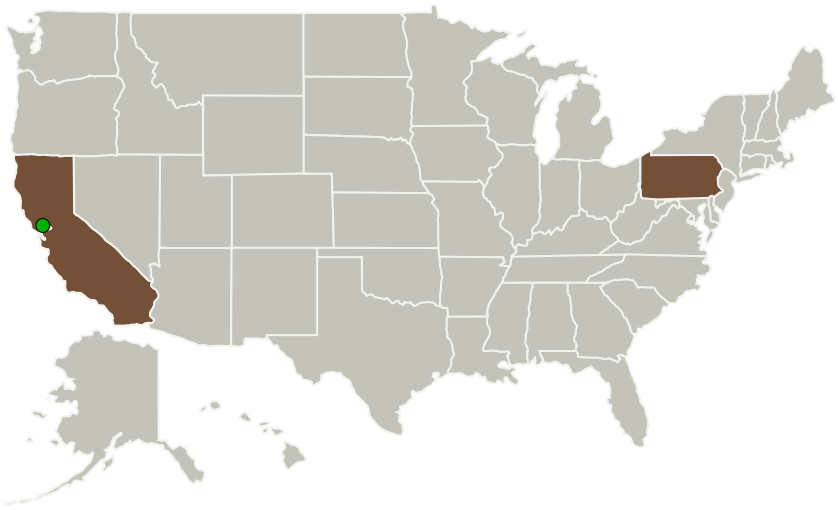
Carlos Torrez

Continued on following page.

MeshSLAM: Robust Localization and Large-Scale Mapping in Barren Terrain, Phase I

Completed Technology Project (2013 - 2014)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Mesh Robotics, LLC	Lead Organization	Industry	Pittsburgh, Pennsylvania
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

May 2013: Project Start

May 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140482)*

Project Management *(cont.)*

Principal Investigator:

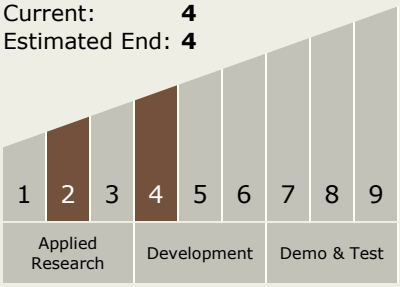
David Wettergreen

Co-Investigator:

David Wettergreen

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.1 Sensing and Perception
    - TX04.1.3 Onboard Mapping and Data Analysis

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System

MeshSLAM: Robust Localization and Large-Scale Mapping in Barren Terrain, Phase I

Completed Technology Project (2013 - 2014)

Images

Project Image
MeshSLAM: Robust Localization and Large-Scale Mapping in Barren Terrain
(https://techport.nasa.gov/image/132245)